

The Deep Troposphere of Uranus from 1981 to 2002

Mark Hofstadter and Bryan Butler

We have analyzed microwave maps of Uranus made with the VLA in 1981, 1985, 1989, 1994, and 2002. The observations, at wavelengths of 2 and 6 cm, are sensitive to the atmosphere between 5 and 50 bars. Over this time Uranus moved from early southern summer to early fall. All maps show the planet to be strongly bi-modal: a region around the South Pole is consistently much brighter than all other latitudes. The 2002 map, which sees as far as +70 North, shows no bright region at high northern latitudes. Analysis of the 2002 data is still underway, but between 1981 and 1994 the transition latitude between bright and dark regions remained close to -45 S. The contrast between the two regions, however, increased between 1989 and 1994.

The most likely explanation for brightness features on the planet is spatial variations in the abundance of absorbers such as NH₃ and H₂O. Bright regions are depleted in absorbers. Since these species are condensable, atmospheric circulation and cloud formation can create the observed spatial variations. The changes we see over time might therefore be related to seasonal variations in the deep circulation. The dynamical model of Friedson and Ingersoll (1987, *Icarus* 69,143-156) does predict a bi-modal atmosphere, with some latitudes being convective and others stably stratified, but it does not predict meridional variability as deep as we have seen.

We will continue to observe Uranus throughout its equinox passage in 2007. For reasons of symmetry, we expect to see the bright region around the South Pole fade, and a new bright region form in the north. We are coordinating our work with observers at visible and infrared wavelengths, in hopes of developing a comprehensive picture of the troposphere and better constraining dynamical models. We are also working with the Goldstone-Apple Valley Radio Telescope science education partnership, which has a single-dish radio telescope operated by students in support of professional astronomers.

The work of M. Hofstadter was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.